Marked-Up Version of Amendments Submitted With Request for Continued Examination

2040. (amended) The method of claim 2039, wherein the one or more heaters comprise at least two heaters, and wherein superposition of heat from at least the two heaters pyrolyzes at least some hydrocarbons within the part of the formation ~~from about 270 °C to about 400 °C~~.

2047. (amended) The method of claim 2039, further comprising controlling the heat such that an average heating rate of the part of the formation is less than about 1 °C per day ~~during pyrolysis~~ in a pyrolysis temperature range from about 270 °C to about 400 °C.

2048. (amended) The method of claim 2039, wherein providing heat from the one or more heaters to at least the portion of the formation comprises:

heating a selected volume (V) of the hydrocarbon containing formation from the one or more heaters, wherein the formation has an average heat capacity (C_v), and wherein the heating pyrolyzes at least some hydrocarbons within the selected volume of the formation; and

wherein heating energy/day (Pwr) provided to the selected volume is equal to or less than $h*V*C_v*\rho_B$, wherein ρ_B is an average formation bulk density, and wherein an average heating rate (h) of the selected volume is ~~less than~~ about 10 °C/day.

2050. (amended) The method of claim 2039, wherein allowing the heat to transfer to the part of the formation heats ~~providing heat from the one or more heaters comprises heating~~ the part of the formation ~~such that~~ to increase a thermal conductivity of at least a portion of the part of the formation ~~is~~ to greater than about 0.5 W/(m °C).

2062. (amended) The method of claim 2039, wherein the produced mixture comprises a non-condensable component, wherein the non-condensable component comprises molecular hydrogen, wherein the molecular hydrogen is greater than about 10 % by volume of the non-condensable component at 25 °C and one atmosphere absolute pressure, and wherein the molecular hydrogen is less than about 80 % by volume of the non-condensable component at 25 °C and one atmosphere absolute pressure.

2072. (amended) The method of claim 2039, wherein allowing the heat to transfer ~~comprises increasing~~ increases a permeability of a majority of the part of the formation to greater than about ~~100~~ 250 millidarcy.

2073. (amended) The method of claim 2039, wherein allowing the heat to transfer ~~further comprises substantially uniformly increasing~~ increases a permeability of a majority of the part of the formation such that the permeability of the majority of the part is substantially uniform.

2086. (amended) The method of claim 2078, further comprising controlling the heat such that an average heating rate of the part of the formation is less than about 1 °C per day ~~during pyrolysis within~~in a pyrolysis temperature range of about 270 °C to about 400 °C.

2087. (amended) The method of claim 2078, wherein providing heat from the one or more heaters to at least the portion of the formation comprises:

heating a selected volume (V) of the hydrocarbon containing formation from the one or more heaters, wherein the formation has an average heat capacity (C_v), and wherein the heating pyrolyzes at least some hydrocarbons within the selected volume of the formation; and

wherein heating energy/day (Pwr) provided to the selected volume is equal to or less than $h*V*C_v*\rho_B$, wherein ρ_B is an average formation bulk density, and wherein an average heating rate (h) of the selected volume is ~~less than~~ about 10 °C/day.

2089. (amended) The method of claim 2078, wherein allowing the heat to transfer to the part of the formation heats ~~providing heat from the one or more heaters comprises heating~~ the part of the formation ~~such that~~to increase a thermal conductivity of at least a portion of the part of the formation ~~is~~ to greater than about 0.5 W/(m °C).

2101. (amended) The method of claim 2078, wherein the produced mixture comprises a non-condensable component, wherein the non-condensable component comprises molecular hydrogen, wherein the molecular hydrogen is greater than about 10 % by volume of the non-condensable component at 25 °C and one atmosphere absolute pressure, and wherein the

molecular hydrogen is less than about 80 % by volume of the non-condensable component at 25 °C and one atmosphere absolute pressure.

2111. (amended) The method of claim 2078, wherein allowing the heat to transfer ~~comprises increasing~~ increases a permeability of a majority of the part of the formation to greater than about ~~100~~ 250 millidarcy.

2112. (amended) The method of claim 2078, wherein allowing the heat to transfer ~~further comprises substantially uniformly increasing~~increases a permeability of a majority of the part of the formation such that the permeability of the majority of the part is substantially uniform.

5398. (amended) A method of treating a hydrocarbon containing formation in situ, comprising:

evaluating a moisture content of hydrocarbon containing material in the hydrocarbon containing formation to identify a portion of the hydrocarbon containing material with ~~an~~ a moisture content that is less than about 20%;

providing heat from one or more heaters positioned in heater wells to the portion to ~~raise temperature in~~heat the portion so that an average temperature in the portion is above a temperature sufficient to pyrolyze hydrocarbon containing material in the portion; and

producing a mixture from the formation.

5403. (amended) The method of claim 5398, wherein providing heat from the one or more heaters to at least the portion of the formation comprises:

heating a selected volume (V) of the hydrocarbon containing formation from the one or more heaters, wherein the formation has an average heat capacity (C_v), and wherein the heating pyrolyzes at least some hydrocarbons within the selected volume of the formation; and

wherein heating energy/day (Pwr) provided to the selected volume is equal to or less than $h*V*C_v*\rho_B$, wherein ρ_B is an average formation bulk density, and wherein an average heating rate (h) of the selected volume is ~~less than~~ about 10 °C/day.

Response

A. Pending Claims

Claims 2039-2116 and 5396-5403 are pending in the case. Claims 2040, 2047, 2048, 2050, 2062, 2072, 2073, 2086, 2087, 2089, 2101, 2111, 2112, 5398, and 5403 have been amended. Claims 2040, 2047, 2048, 2050, 2062, 2073, 2086, 2087, 2089, 2101, 2112, and 5403 have been amended for clarification and/or correction of typographical errors.

B. Provisional Double Patenting Rejection

Applicant acknowledges the Examiner's agreement to suspend the double patenting rejections until the claims are condition for allowance but for the double patenting rejection.

C. The Claims Are Not Anticipated By Tsai et al. Pursuant To 35 U.S.C. § 102(b)

The Examiner rejected claims 2039, 2041, 2044, 2045, 2049, 2065, 2072-2074, 2078, 2080, 2083, 2088, 2104 and 2111-2113 under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 4,299,285 to Tsai et al. (hereinafter "Tsai"). Applicant respectfully disagrees with these rejections.

The standard for "anticipation" is one of fairly strict identity. To anticipate a claim of a patent, a single prior source must contain all the claimed essential elements. *Hybritech, Inc. v. Monoclonal Antibodies, Inc.*, 802 F.2d 1367, 231 U.S.P.Q.81, 91 (Fed.Cir. 1986); *In re Donahue*, 766 F.2d 531, 226 U.S.P.Q. 619, 621 (Fed.Cir. 1985).

Claim 2039 describes a combination of features including: "providing heat from one or more heaters to at least a portion of the formation". Claim 2078 describes a combination of features including: "providing heat from one or more heaters to a part of the formation".

The Examiner states:

> With regards to independent claims 2039 and 2078; applicant has argued that the Tsai reference fails to teach or suggest "providing heat from one or more heaters to at least a portion of the formation". Applicant also provides text from the specification to support a definition of "heater", which would exclude the fire taught by Tsai.
>
> It is noted that applicant's specification also includes much broader definitions of "heater", which include fire....

The Examiner quotes from page 3, lines 20-28 of the Specification. Applicant respectfully disagrees with the Examiner's characterization of Applicant's Specification. The portion of Applicant's Specification that the Examiner cited is under the section "Description of Related Art". The description of related art describes to the extent practical the state of the prior art or other information disclosed known to the applicant. MPEP 608.01(c). The description of a heater cited from page 40 of the Applicant's Specification is from the Specification section titled "Detailed Description of the Invention". An applicant may be his or her own lexicographer. *In re Hill*, 161 F.2d 367, 73 U.S.P.Q. 482 (C.C.P.A. 1947); MPEP 2111.01.

Applicant submits that a "heater" has been described at least on page 40 of the Applicant's Specification. When a specification provides definitions for terms appearing in the claims, the specification can be used in interpreting claim language. *In re Vogel*, 422 F.2d 438, 441, 164 U.S.P.Q. 619, 622 (C.C.P.A. 1970); MPEP 2111.01. The Examiner agrees that the "text from the specification...support[s] a definition of 'heater', which would exclude the fire taught by Tsai." Thus, since the Applicant has described a "heater" at least on page 40 of Applicant's Specification and the Examiner has agreed that the definition does exclude the method taught by Tsai, Applicant respectfully requests the removal of the rejections of claims 2039 and 2078 and the claims dependent thereon. Applicant further submits that many of the claims dependent on claims 2039 and 2078 are separately patentable.

Claims 2044 and 2083 describe a combination of features including: "wherein at least one of the one or more heaters comprises a flameless distributed combustor." The Examiner states: "With regards to claim 2044; the Tsai reference teaches a flameless combustor (see col. 2, line 32)." The Examiner further states: "With regards to claim 2083; the Tsai reference teaches a flameless combustor (see col. 2., line 32)."

In reference to flameless combustion, Applicant's Specification teaches:

> Flameless combustion may be accomplished by preheating a fuel and combustion air to a temperature above an auto-ignition temperature of the mixture. The fuel and combustion air may be mixed in a heating zone to combust. In the heating zone of the flameless combustor, a catalytic surface may be provided to lower the auto-ignition temperature of the fuel and air mixture. (Specification, page 4, lines 2-6)

Applicant's Specification also teaches:

> FIG. 28 illustrates an embodiment of a flameless combustor configured to heat a section of the hydrocarbon containing formation. (Specification, page 119, lines 7-8)

> Oxidation of fuel fluid 621 may provide heat generation within outer conduit 636. The generated heat may provide heat to at least a portion of a hydrocarbon containing formation proximate to the oxidation region of inner conduit 638. Products 625 from oxidation of fuel fluid 621 may be removed through outer conduit 636 outside inner conduit 638. (Specification, page 119, line 28 to page 120, line 2)

Claims 2045 and 2084 describe a combination of features including: "wherein at least one of the one or more heaters comprises a natural distributed combustor." The Examiner states: "With regards to claim 2045; the Tsai reference teaches a natural distributed combustor (see col. 2, line 32)." The Examiner further states: "With regards to claim 2084; the Tsai reference teaches a natural distributed combustor (see col. 2, line 32)."

Applicant's Specification teaches, in reference to a natural distributed combustor:

> As used herein, the phrase "natural distributed combustor" generally refers to a heater that uses an oxidant to oxidize at least a portion of the carbon

> in the formation to generate heat, and wherein the oxidation takes place in a vicinity proximate to a wellbore. Most of the combustion products produced in the natural distributed combustor are removed through the wellbore. (Specification, page 40, lines 19-24)
>
> Although the heat from the oxidation is transferred to the formation, oxidation product 519 (and excess oxidation fluid such as air) may be substantially inhibited from flowing through the formation and/or to a production well within formation 516. Instead oxidation product 519 (and excess oxidation fluid) is removed (e.g., through a conduit such as conduit 512) as is described herein. In this manner, heat is transferred to the formation from the oxidation but exposure of the pyrolysis zone with oxidation product 519 and/or oxidation fluid may be substantially inhibited and/or prevented. (Specification, page 77, lines 18-24)

Tsai does not appear to teach a heater such as a natural distributed combustor or a flameless combustor. Tsai appears to teach starting a fire in the coal bed. Tsai states, "the oxidizing gas is injected into the injection hole at an appropriate rate and the fire is started in the coal bed at the injection well." (Tsai, col. 2, lines 31-34) Applicant submits that the combinations of features in claims 2044, 2045, 2083, and 2084 do not appear to be taught or suggested by the cited art. Applicant respectfully requests removal of the rejections of claims 2044, 2045, 2083, and 2084.

The Examiner states in regards to claims 2049 and 2088:

> the Tsai reference does not explicitly teach the transferring by conduction; however this is inherent in a solid substance such as coal. Even though the bulk of the heating in the Tsai method may be done by convection; it is apparent that some unfractured coal must remain, and thus allowing heat to transfer comprises transferring heat substantially by conduction (that is, substantially within the unfractured portions).

The Examiner also states "[i]t should be abundantly clear that heat transfer in a solid substance such as coal inherently includes conduction."

Claims 2049 and 2088 describe a combination of features including, but not limited to, "wherein allowing the heat to transfer comprises transferring heat substantially by conduction." The Examiner states: "the bulk of the heating in the Tsai method may be done by convection...." "Substantially" is defined as "largely; essentially; in the main." (*Webster's New Twentieth Century Dictionary Unabridged, 2nd ed.*) Since Tsai teaches largely or essentially heating by convection, transferring heat substantially by conduction is precluded. Therefore, Tsai does not appear to teach or suggest all the features of claims 2049 and 2088. Applicant respectfully requests removal of the rejections of claims 2049 and 2088.

The Examiner states: "With regards to claim 2065, the Tsai reference teaches the pressure greater than 2.0 bar." The Examiner further states: "With regards to claim 2104, the Tsai reference teaches the pressure greater than 2.0 bar." Tsai states: "Air is heated to a temperature of about 250 °C and is injected into the injection well at a pressure of approximately 500 psi.... Combustion air at ambient temperature is now injected into the injection hole at a pressure of 50 psi...." (Tsai, col. 7, line 62-col. 8, line 11)

Claims 2065 and 2104 describe a combination of features including: "controlling a pressure within at least a majority of the part of the formation, wherein the controlled pressure is at least about 2.0 bar absolute." Applicant submits that Tsai does not appear to teach or suggest controlling a pressure within a formation or within at least a majority of a part of a formation. Tsai appears, instead, to teach a pressure of air injected into a formation. At least the above-quoted features of the claims, in combination with other features of the claims, do not appear to be taught or suggested by the cited art. Applicant respectfully requests removal of the rejections of claims 2065 and 2104.

The Examiner states: "With regards to claims 2072 [2111] and 2073 [2112]; the Tsai reference teaches the permeability greater than about 100 md in table 1. The uniform increase in permeability is inherent." Contrary to the Examiner's statement that "applicant has failed to provide any evidence that the uniform increase of permeability is not inherent," Applicant submits that, in relying upon the theory of inherency, the Examiner must provide a basis in fact

and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art. In some situations, heating caused by a fireflood may increase permeability in local areas through which the fireflood has passed, but such heating will not result in a uniform increase in permeability.

Amended claims 2072 and 2111 describe a combination of features including: "wherein allowing the heat to transfer increases a permeability of a majority of the part of the formation to greater than about 250 millidarcy." Support for amendments to the claims is found in the Specification as follows:

> Permeability of a selected section within the heated portion of the hydrocarbon containing formation may also rapidly increase while the selected section is heated by conduction. For example, permeability of an impermeable hydrocarbon containing formation may be less than about 0.1 millidarcy (9.9 x 10^{-17} m^2) before treatment. In some embodiments, pyrolyzing at least a portion of a hydrocarbon containing formation may increase a permeability within a selected section of the portion to greater than about 10 millidarcy, 100 millidarcy, 1 Darcy, 10 Darcy, 20 Darcy, or 50 Darcy. Therefore, a permeability of a selected section of the portion may increase by a factor of more than about 1,000, 10,000, or 100,000. (Specification, page 151, line 28-page 152, line 5)

Amended claims 2073 and 2112 describe a combination of features including: "wherein allowing the heat to transfer increases a permeability of a majority of the part of the formation such that the permeability of the majority of the part is substantially uniform."

Permeabilities recorded in Table I of Tsai do not appear to be substantially uniform. Tsai states: "The initial permeability of the core was 2.0, after two days it was 27.5, after three days it was 77.2 and after four days it was 107 as reported in Table I." (Tsai, col. 7, lines 11-14) In addition, Table I of Tsai discloses a permeability of 107 md for Ex. 6 and a permeability of 148 md for Ex. 7, in which the axis of the core was perpendicular to the bedding plane. Tsai also states: "It should be appreciated that the coal, following the pretreatment and conditioning procedure, will exhibit a zone of increasing free swelling index and a decreasing permeability in

a direction away from the fracture-induced linkage until non-affected coal is reached." (Tsai, col. 5, lines 32-37) Tsai does not appear to teach or suggest at least the above-quoted features of claims 2073 and 2112. Applicant submits at least the above-quoted features of claims 2073 and 2112, in combination with other features of the claims, do not appear to be taught or suggested by the cited art. Applicant respectfully requests removal of the rejections of claims 2073 and 2112.

Claims 2074 and 2113 describe a combination of features including: "controlling the heat to yield greater than about 60 % by weight of condensable hydrocarbons, as measured by the Fischer Assay." The Examiner states: "With regards to claim 2074 [2113]; although the Tsai reference fails to explicitly disclose a Fischer Assay; it is apparent that the disclosed process will yield greater than 60%." Applicant submits that features of claims 2074 and 2113 do not appear to be taught or suggested by the cited art. In relying upon the theory of inherency, the Examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art. Otherwise, Applicant respectfully requests removal of the rejections of claims 2074 and 2113.

D. The Claims Are Not Anticipated By Terry Pursuant To 35 U.S.C. § 102(b)

The Examiner rejected claims 5398, 5400, 5401, and 5402 under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 4,093,025 to Terry (hereinafter "Terry"). Applicant respectfully disagrees with these rejections.

The Examiner states: "Terry teaches a method of treating a hydrocarbon formation including evaluating a moisture content (see col. 7, lines 1-2); providing heat from one or more heaters so that an average temperature is above a pyrolysis temperature; and producing a mixture as called for in claim 5398—with regards to the moisture less than 20%; this is inherent in coal as shown in figure 2.11 and o section 4.3 of "Coalbed Methane".

Amended claim 5398 describes a combination of features including: "providing heat from one or more heaters positioned in heater wells to the portion to heat the portion so that an average temperature in the portion is above a temperature sufficient to pyrolyze hydrocarbon containing material in the portion". Support for the amendment to claim 5398 is found in the Specification at least on page 40, lines 6-11.

In the Specification, a heater is described as "any system configured to generate heat in a well or a near wellbore region." (Specification, page 40, lines 6-7) Terry states: "Wells to be ignited are pumped free of water, ignition material, such as hot ceramic balls 10, are positioned in the coal strata, and oxygen is injected into the coal formation through an injection conduit 12 as the formation is set on fire." (Terry, col. 7, lines 61-65) Terry appears to teach heating a coal seam by in situ combustion of the coal. The ceramic balls of Terry do not "generate heat in a well or a near wellbore region." Applicant submits that Terry does not appear to teach or suggest heating a formation with heaters positioned in heater wells as recited in claim 5398. Applicant respectfully requests removal of the rejections of claim 5398 and claims dependent thereon.

The Examiner states: "Terry also shows at least 7 heaters per production well as called for in claim 5402." Claim 5402 describes a combination of features including: "wherein at least about 7 heaters are disposed in the formation for each production well." Applicant submits that the ceramic balls of Terry do not "generate heat in a well or a near wellbore region." At least the above-quoted features of the claim, in combination with other features of the claim, do not appear to be taught or suggested by the cited art. Applicant respectfully requests removal of the rejection of claim 5402.

E. The Claims Are Not Obvious Over Tsai Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 2042, 2043, 2050-2062, 2066, 2067, 2081, 2082, 2089-2101, 2105, and 2106 under 35 U.S.C. § 103(a) as being unpatentable over Tsai. Applicant respectfully disagrees with these rejections.

In order to reject a claim as obvious, the Examiner has the burden of establishing a *prima facie* case of obviousness. *In re Warner et al.*, 379 F.2d 1011, 154 USPQ 173, 177-178 (CCPA 1967). To establish a *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180 U.S.P.Q. 580 (C.C.P.A. 1974), MPEP § 2143.03.

If an independent claim is nonobvious under 35 U.S.C. § 103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988). For at least the reasons cited in Section D, independent claims 2039 and 2078 are not obvious over the cited art. Applicant respectfully requests removal of the rejections of claims 2042, 2043, 2050-2062, 2066, 2067, 2081, 2082, 2089-2101, 2105, and 2106. Applicant further submits that many of the rejected claims are separately patentable.

The Examiner states: "it would have been obvious to one of ordinary skill in the art at the time of the invention to have practiced the Tsai method in a coal seam having a thermal conductivity of greater than about 0.5 W/(m °C) as called for in claims 2050 and 2089". Applicant submits that practicing the Tsai method in a coal seam having a thermal conductivity of greater than about 0.5 W/(m °C) is not equivalent to "increasing a thermal conductivity of at least a portion of the part of the formation to greater than about 0.5 W/(m °C)", as recited in claims 2050 and 2089. Applicant submits that features of claims 2050 and 2089 are unexpected based on literature in the art. For example, Applicant's Specification states:

> Certain embodiments described herein will in many instances be able to economically treat formations that were previously believed to be uneconomical. Such treatment will be possible because of the surprising increases in thermal conductivity and thermal diffusivity that can be achieved with such embodiments. These surprising results are illustrated by the fact that prior literature indicated that certain hydrocarbon containing formations, such as coal, exhibited relatively low values for thermal conductivity and thermal diffusivity when heated. For example, in government report No. 8364 by J. M. Singer and R. P. Tye entitled "Thermal, Mechanical, and Physical Properties of Selected Bituminous Coals and Cokes," U.S. Department of the Interior, Bureau of Mines (1979), the authors report the thermal conductivity and thermal diffusivity for four bituminous coals. This government report includes

> graphs of thermal conductivity and diffusivity that show relatively low values up to about 400 °C (e.g., thermal conductivity is about 0.2 W/(m °C) or below, and thermal diffusivity is below about 1.7 x 10^{-3} cm^2/s). This government report states that 'coals and cokes are excellent thermal insulators.'
>
> In contrast, in certain embodiments described herein hydrocarbon containing resources (e.g., coal) may be treated such that the thermal conductivity and thermal diffusivity are significantly higher (e.g., thermal conductivity at or above about 0.5 W/(m °C) and thermal diffusivity at or above 4.1 x 10^{-3} cm^2/s) than would be expected based on previous literature such as government report No. 8364. If treated as described in certain embodiments herein, coal does not act as 'an excellent thermal insulator.' Instead, heat can and does transfer and/or diffuse into the formation at significantly higher (and better) rates than would be expected according to the literature, thereby significantly enhancing economic viability of treating the formation.
> (Specification, page 150, line 18 to page 151, line 10)

Applicant submits that at least the above-quoted features of claims 2050 and 2089 are not obvious. Applicant respectfully requests removal of the rejections of claims 2050 and 2089.

F. The Claims Are Not Obvious Over Tsai In View Of Kasevich et al. Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 2047, 2048, 2086, and 2087 under 35 U.S.C. § 103(a) as being unpatentable over Tsai in view of U.S. Patent No. 4,457,365 to Kasevich et al. (hereinafter "Kasevich"). Applicant respectfully disagrees with these rejections.

Amended claims 2047 and 2086 describe a combination of features including: "controlling the heat such that an average heating rate of the part of the formation is less than about 1 °C per day in a pyrolysis temperature range of about 270 °C to about 400 °C."

Kasevich states: "this invention provides for heating kerogen in oil shale with electric fields having frequency components in the range between 100 kilohertz and 100 megahertz where dry oil shale is selectively heated, with kerogen-rich regions absorbing energy from said fields at substantially higher rates than kerogen-lean regions." (Kasevich, col. 2, lines 9-15)

Tsai states: "This invention relates to the in situ combustion and gasification of a swelling bituminous coal by the injection of air for combustion into the coal bed from one or more injection holes and the production of a combustible gas from one or more production holes." (Tsai, col. 1, lines 6-10)

Obviousness can only be established by "showing some objective teaching in the prior art or that knowledge generally available to one of ordinary skill in the art would lead that individual to combine the relevant teaching of the references." *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596, 1598 (Fed. Cir. 1988). Applicant respectfully submits that the features of the electric field heating method of Kasevich for an oil shale formation would not be suitable for modifying the in situ combustion process of Tsai for a coal formation to produce the features described in claims 2047, 2048, 2086, and 2087.

The Examiner states: "since the increase of temperature stops, the heating must inherently comprise a rate of increase less than than 1.6°C." Kasevich states: "Thus, if the kerogen were heated from 150 °C. to 500 °C. at the rate of 50 °C./month, the absorption rate would approximate that of curve 114 [in Figure 3], while more rapid heating rates would produce curves 120, 122 and 124 for heating rates of 50 °C. per month, 50 °C./day, 50 °C./hour and 50 °C./minute, respectively" (Kasevich, col. 8, lines 57-62).

Figure 3 of Kasevich shows a heating rate of 50 °C/month, which may correspond to an average heating rate of about 1.6 °C/day. Kasevich, however, does not appear to teach or suggest the features of amended claims 2047 and 2086 including: "controlling the heat such that an average heating rate of the part of the formation is less than about 1 °C per day in a pyrolysis temperature range of about 270 °C to about 400 °C." At least the above-quoted features of claims 2047 and 2086, in combination with other features of the claims, do not appear to be taught or suggested by a combination of the cited art. Applicant respectfully requests removal of the rejections of claims 2047 and 2086.

The Examiner states:

> With regards to claims 2048 and 2087; it is known to heat at rates of less than 10°C per day, as shown by Kasevich (figure 3). It is apparent that this low heating rate is desirable because it results in more uniform heating, and reduces the possibility of hot spots. It would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the Tsai method to have included heating at a rate of less than about 10°C per day as called for in claims 2048 and 2087 in order to achieve more uniform heating. The claim limitations drawn to the heating energy are nothing more than well known thermodynamic equations.

The Examiner further states: "the claims do not call for 'using a desired heating rate to calculate a maximum amount of heating'." Applicant respectfully disagrees with the Examiner's characterization of claims 2048 and 2087. Amended claims 2048 and 2087 describe a combination of features including: "wherein heating energy/day (*Pwr*) provided to the selected volume is equal to or less than $h*V*C_v*\rho_B$, wherein ρ_B is formation bulk density, and wherein an average heating rate (h) of the selected volume is about 10 °C/day." The claims describe heating energy/day (*Pwr*) provided to the selected volume. The heating energy/day (*Pwr*) provided to the selected volume is equal to or less than a product of the average heating rate, the selected volume, the average heat capacity of the formation, and the formation bulk density. For a selected volume of a formation, the average heating energy/day required to achieve a desired average heating rate (in this case about 10 °C/day) may be calculated and applied to the selected volume. The calculated average heating energy/day will be the maximum average heating energy/day that may be applied to the formation without exceeding the desired average heating rate. Applicant respectfully maintains that the combination of Tsai and Kasevich do not appear to teach or suggest using a desired heating rate to calculate a maximum average heating energy/day to be applied to a selected volume of a formation. Applicant respectfully requests removal of the rejections of claims 2048 and 2087.

G. The Claims Are Not Obvious Over Tsai In View of Stoddard et al. Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 2063, 2064, 2102 and 2103 under 35 U.S.C. § 103(a) as being unpatentable over Tsai in view of U.S. Patent No. 4,463,807 to Stoddard et al. (hereinafter "Stoddard"). Applicant respectfully disagrees with these rejections.

The mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination. *In re Mills*, 916 F.2d 680, 16 USPQ2d 1430 (Fed. Cir. 1990). Applicant submits that there does not appear to be any evidence to support the desirability of a combination of Tsai and Stoddard. Thus, the Examiner's rejection appears to be based on improper hindsight reasoning. While it may be "well know that ammonia is a byproduct of such heating of coal", as stated by the Examiner, the combination of Tsai and Stoddard does not appear to teach or suggest the desirability of producing a mixture comprising ammonia from a hydrocarbon containing formation and/or using a ammonia from a mixture produced from a hydrocarbon containing formation to produce fertilizer. Applicant respectfully requests removal of the rejections of claims 2063, 2064, 2102, and 2103.

H. The Claims Are Not Obvious Over Tsai In View of Gregoli et al. Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 2068-2071 and 2107-2110 under 35 U.S.C. § 103(a) as being unpatentable over Tsai in view of U.S. Patent No. 6,016,867 to Gregoli et al. (hereinafter "Gregoli"). Applicant respectfully disagrees with these rejections.

The Examiner states:

> The Tsai reference fails to teach the recirculating hydrogen, providing hydrogen, or hydrogenating. The Gregoli reference teaches that in a similar in-situ processes, it is beneficial to use hydrogen to hydrogenate heavy hydrocarbons....

> It would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the Tsai method to have included recirculating hydrogen as called for in claims 2069 and 2108; providing hydrogen as called for in claims 2070 and 2109; and hydrogenating as called for in claims 2071 and 2110; in order to reduce the heavy hydrocarbons and to improve production.

Figure 1 of Gregoli depicts injection of hydrogen into the reservoir by way of the injection-well borehole. Gregoli does not appear to teach or suggest features of claims 2069 and 2108 including: "controlling formation conditions by recirculating a portion of hydrogen from the mixture into the formation." Gregoli does not appear to teach or suggest features of claims 2071 and 2110 including: "producing hydrogen and condensable hydrocarbons from the formation; and hydrogenating a portion of the produced condensable hydrocarbons with at least a portion of the produced hydrogen." Applicant submits that the Examiner is extending the teaching of Gregoli in the obviousness rejection of claims 2069, 2071, 2108, and 2110. Applicant respectfully requests removal of the rejections of claims 2069, 2071, 2108, and 2110.

I. The Claims Are Not Obvious Over Tsai In View of Van Meurs Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 2040, 2075, 2076, 2079, 2114, 2115, 5396 and 5397 under 35 U.S.C. 103(a) as obvious over Tsai in view of U.S. Patent No. 4,886,118 to Van Meurs et al. (hereinafter "Van Meurs"). Applicant respectfully disagrees with these rejections.

Van Meurs states:

> Even with respect to a five-spot pattern in which a single fluid-producing well is surrounded by four heat-injecting wells, substantially all of the intervening oil shale can be both retorted and made permeable. However, the present invention is preferably employed in a series of contiguous seven—or thirteen-spot patterns—in either of which patterns (particularly in the thirteen-spot pattern) and retorting rate is significantly increased by having each fluid producing well surrounded by six or twelve heat-injecting wells.

Van Meurs appears to teach three discrete patterns for heat-injecting wells. Van Meurs does not appear to teach or suggest a range of heaters for each production well. In particular, Van Meurs does not appear to teach or suggest features of claims 5396 and 5397 including: "wherein at least about 20 heaters are disposed in the formation for each production well." Applicant submits that the Examiner is extending the teaching of Van Meurs in the obviousness rejection of claims 5396 and 5397. Applicant respectfully requests removal of the rejections of claims 5396 and 5397.

J. Claim 5403 Is Not Obvious Over Terry In View of Kasevich Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claim 5403 under 35 U.S.C. § 103(a) as being unpatentable over Terry in view of Kasevich. Applicant respectfully disagrees with this rejection.

Amended claim 5403 describes a combination of features including: "wherein heating energy/day (*Pwr*) provided to the selected volume is equal to or less than $h*V*C_v*\rho_B$, wherein ρ_B is an average formation bulk density, and wherein an average heating rate (h) of the selected volume is about 10 °C/day."

Terry discloses: "A method of producing combustible gases, synthetic crude oils, coal chemicals and heat from coal in situ utilizes the combined teachings of in situ gasification, liquefaction and pyrolysis." (Terry, Abstract, lines 1-4) Applicant submits that the features of the electric field heating method of Kasevich for an oil shale formation would not be suitable for modifying the in situ combustion process of Terry for a coal formation to produce the features described in claim 5403. Applicant respectfully requests removal of the rejection of claim 5403.

K. Additional Comments

Applicant submits that all claims are in condition for allowance. Favorable consideration is respectfully requested.

A Fee Authorization is enclosed to cover charges associated with filing a Request for Continued Examination and a one-month extension of time. If any further extension of time is required, Applicant hereby requests the appropriate extension of time. If any additional fees are required, or if fees have been overpaid, please appropriately charge or credit those fees to Meyertons, Hood, Kivlin, Kowert & Goetzel, P.C. Deposit Account Number 50-1505/5659-02200/EBM.

Respectfully submitted,

Eric B. Meyertons
Reg. No. 34,876

Attorney for Applicant

MEYERTONS, HOOD, KIVLIN, KOWERT & GOETZEL, P.C.
P.O. Box 398
Austin, TX 78767-0398
(512) 853-8800 (voice)
(512) 853-8801 (facsimile)

Date: 4-9-03